

*the Colouring Matter of the Pink and Red Vulcanite used in Dentistry; with Remarks on the Occasional Occurrence of Symptoms of Poisoning, probably dependent upon the Vermilion used as a Pigment.* By W. BATHURST WOODMAN, M.D., M.R.C.P., &c.

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PRESIDENT AND GENTLEMEN,

THE cases and remarks which form the basis of this paper were published, under the heading of "Hospital Reports," in the *Medical Press and Circular*, of December 9th, 1874; but having been requested by your honorary secretaries, Mr. Sewill and Mr. Turner, to embody the same in a short paper for your Society, I was led to make some fresh experiments; and, in the meanwhile, one or two fresh cases, though of less or severity, have come under my notice. I am indebted to the kindness of Mr. Turner for the interesting

references to your own Transactions, and to American Dental literature, which form Appendices Nos. I.—V.; and I am further indebted to him for much valuable information on details of manufacture; there are also several suggestions of his which will appear in their own place in the course of the paper. My thanks are also due to my colleague, Dr. Barrett, Dentist to the London Hospital, for kindly favouring me with specimens of variously tinted rubber, showing me the apparatus used in hardening, and suggesting one or two of the later experiments. Before formally entering upon my subject, I wish to make two disclaimers, as due both to my audience and myself, viz.:—

Whilst I alone am responsible for the accuracy of the experiments; and although my first case was observed by me in 1862, when house-surgeon to the Torbay Infirmary, whereas Dr. Taylor's case was not noted till 1864,\* and Dr. Well's case only one year before,† and up to the time of my *writing* my first paper, I had seen no notice of such cases; yet, I am far from wishing to claim any priority as to the *discovery* of the facts. These personal matters appear to me of very

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\* See his "Principles and Practice of Medical Jurisprudence," 2nd edition, vol. i. p. 290.

† See "British Medical Journal," September 5th, 1863.

small moment ; and medical literature is so voluminous that it is scarcely possible to be sure of any such question of pre-publication. Dr. Sutro's case of poisoning by the vapour of vermilion seems to be one of the earliest in modern literature, having appeared in the *Medical Times* as long ago as September 27th, 1845. Here, however, it was used as a fumigation, for a cancerous breast. The references in the Appendix, kindly given by Mr. Turner, show that the danger was foreseen as long ago as 1859 ;—being combated by Mr. Putnam, and again in 1866, by Mr. R. Hepburn. It also appears that this matter is being eagerly discussed by American Dentists and Physicians. Here, however, I must remark that my first paper, though not published till December, was written several months before, and in the editor's hands before these American journals reached England.

My second disclaimer is of any wish to make a sensational matter of this question. It appears to me evident that the cases I am about to describe are more or less exceptional. In other words, whilst large numbers of patients are wearing and have worn these vulcanite plates for years, only a small percentage of them have suffered at all severely, or perhaps suffered at all. But I believe the public look to you and to the medical profession to guide public opinion, to lead the way to

improvements, and to obviate dangers and difficulties ; rather than to be forced by popular prejudices, or made yield to any popular cry. Of one thing I am quite confident, and that is that your Society will give the matter a careful consideration ; and will not only be ready but glad to welcome any substitute for vermilion, or even for rubber itself, which may prove more safe and equally convenient.

When my first case of " Ptyalism, rupoid eruptions, stomatitis phagedenica, and mercurial erythism," in a patient wearing one of these plates, was observed by me in 1862, I satisfied myself that the colouring matter in that instance was vermilion. When another case occurred in London, in 1864, I obtained a number of samples of pink and red rubbers, some by purchase in various quarters, whilst others were procured for me by Dr. Martin H. Payne, then in the Dental profession. I have lately examined a number of fresh samples, both hard and soft, that is, rubbers and vulcanites, or ebonites, as I think some call them, though that name is scarcely appropriate to the colours we are considering. One and all, whether pink or red, were coloured with vermilion, the red sulphide, or sulphuret of mercury. I do not profess to be an analytical chemist, at least as regards *quantitative* analysis ; but my experiments led me to the conclusion that the deeper

tinted ones usually contained about one-third, or some 33 to 34 per cent. of this pigment,—a result which differs but little from that given in Appendix V. from the “Dental Cosmos,” which states the percentage at 36 per cent. The proportion of pigment can only be approximatively judged by the colour, some very pretty and natural-looking specimens containing less vermilion than some which do not look so well.

Although certain natural resemblances in appearance and composition led me to believe that nearly all the rubbers used in this country were manufactured by some three or four, or at most, half a dozen firms, yet I must own I was surprised to find this mineral pigment in *all* the specimens examined (the total number of samples being nearly a hundred).\* Mr. Turner, however, has given what appears to me a very reasonable explanation, which I suppose to be the *vera causa*, namely, that there is scarcely any other colouring matter known, at least of the desired tint, which would withstand the action of the  $H_2S$ , or hydrogen sulphide, and other sulphur compounds (such as  $SO_2$ ) generated in the process of hardening or vulcanizing the rubber. I think I

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\* It is an act of only simple justice to Messrs. Ash to state, that the rubbers manufactured by them were the best and most evenly mixed with the pigment of all the samples examined.

should be travelling out of my province as a physician and a clinical observer, were I to enter upon any description of the processes undergone by the artificial gums, palates, &c., in order to render them suitable for their destined purpose. There are gentlemen here who are familiar with the whole theory and practice of these matters; and I might perhaps be led into mistakes if I trusted to my hasty impressions, derived either from reading, conversation, or hasty peeps into dental *ateliers*. I may, however, without impropriety, allude to one or two little matters which have come under my notice in the examination of specimens, even although they be a little technical. I write as a clinical physician, and not as a scientific chemist, or a technologist. If, therefore, I am wrong in my inferences or theories, I shall be glad of correction. I think I am pretty sure of my facts, but shall be very glad for others to make independent observations, and hope some at least may be induced to repeat my experiments.

The *first* point I observed as to the rubbers supplied for dental purposes is, that the *basis* material was not absolutely identical in all the prepared sheets. It sometimes appeared to consist of india-rubber, pure and simple (I now purposely disregard the pigment), whilst other samples appeared to be mixtures of india-rubber with gutta-percha, and occasionally other vegetable



substances, whose exact nature I do not pretend to determine. I believe the juice of many tropical trees is used to mix with genuine caoutchouc or india-rubber. It appeared to me that these mixtures are important only so far as they affect the fineness and closeness of the *grain*, if I may use that expression, and the firmness and durability of the future product. I concluded from examination of the samples obtained by me (but here I speak under correction), that pure india-rubber, though perhaps not quite so hard as some of the mixtures, is, on the whole, best adapted for these purposes.

The *second* point is, that different specimens of the *hardened product*, or vulcanite, in other words, the gums and palates made by different dentists, and different workmen even, when broken across, or divided in any manner, varied very much in their texture. Some, and these, of course, were the best, were fine, firm, and close in *grain*, if I may say so, and showed scarcely any difference between the surface and the interior. Others had a porous, loose structure in the interior, were marked with little blisters and cracks on the surface, and in the midst of the spongy mass of the inside there were sometimes collections of the *pigment*, *pure and simple*, sometimes crystalline, sometimes amorphous. In others there were patches of Æthiop's mineral, the black sulphide of mercury, or sulphide with sulphur. I am told by Messrs.

Turner and Barrett that these faults are capable of being avoided by proper apparatus, and a proper way of working. I have been led to believe that in the provinces, at least, some dentists use only a common oven, by the side of a fire, or heated underneath, to harden their plates. Such a method seems to me very liable to lead to "faults" in the finished material.

It was, with one exception, "faulty" plates which gave rise to the cases of mercurial poisoning observed by me. In the exceptional case, an old lady referred to as Case III. in the *Medical Press and Circular* (*loc. cit.*), the plate worn by her seemed to me to be quite a finished specimen of dental art, and quite free from the "faults" referred to.

As to the pigment itself, it is only necessary, in an audience like this, to remind you that the red sulphide of mercury, now generally regarded as represented by the formula  $\text{HgS}$ , or 200 of mercury and 32 of sulphur (about 6 of the metal to 1 of the other element), is one of the oldest known compounds of that metal, being found native in Spain, the Balearic Isles, some parts of Italy, Austria, China, and the New World. The largest yield seems undoubtedly to be from the Spanish source of Almaden, in the province of La Mancha. From this, in one year (1827), some 1,100 tons of cinnabar and mercury were sent into the market. Next to this in im-

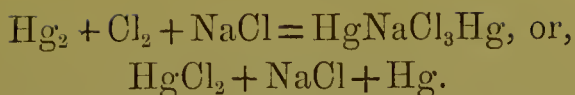


portance are the mines of Idria, in Austrian Carniola, yielding annually about 25 tons of einnabar, and some 150 tons of mercury. Pereira quotes Theophrastus (de Lapidibus) as saying that cinnabar (κιννάβαρι) was accidentally discovered by Callius, about 90 years before the magistracy of Praxibulus of Athens—that is, 494 years before Christ, or some 2,365 years ago. There are, however, good reasons for believing it to have been known much earlier, since Geiger and others have found it in Egyptian tombs and ornaments of great antiquity. When first formed, artificially, whether by mixing sulphur and mercury together, or by preeipitating mereurie salts by hydrogen sulphide, it is blaek, or nearly blaek, in colour; but in being sublimed, assumes the beautiful vermilion colour for which it is prized. The name of *minium*, now generally applied to red lead, was formerly used for this substance. The primary form of its crystals is the aeute rhombohedron. Although Mayne gives its derivation from κιννάβαρι, the gum of an Indian tree, from a similarity of colour; it may, I think, not unreasonably be conjectured that this old name is derived from κίναδος, a fox, a red fox, to signify the colour; and βαρὺς, heavy, or weighty (as in the ease of Baryta). The native product contains, amongst other impurities, slight traces of arsenie, in the form of sulphide ehiefly. One or two of the samples of rubber examined by me

also contained traces of arsenic, but traces only. Red lead, sometimes used as a cheap substitute for vermilion, is not suitable for dental purposes, from its property of blackening by sulphuretted hydrogen. I have found no trace of this in any of the specimens.

Orfila, Mialhe, and other foreign toxicologists and pharmaciens assert that vermilion is an almost *inert* substance. They do so, chiefly on the ground that large doses, such as half an ounce or more, have been given to dogs without symptoms of poisoning. A similar argument might be used to show that calomel also is inert, since enormous doses have been given in cholera and other diseases, to human beings, with slight, if any, results. But the experience of the men who work the cinnabar mines, Dr. Sutro's case, mentioned before, and the experience of Surgeons and Physicians who use it in the form of vapour-baths for syphilis, tend to show, that in this form at least, it is anything but an inert substance.

Mialhe, in his "*Chimie appliquée à la Physiologie et à la Thérapeutique*," p. 396 *et seq.*, has shown, of calomel and some other mercurials, that, when exposed to the action of solutions of the chlorides of ammonium, sodium, and potassium, a certain portion is converted into the [per]chloride, or corrosive sublimate. He supposes the decomposition to be something like this:—



Whatever the exact decomposition may be, it seems pretty certain that a small quantity of corrosive sublimate is so formed when vermilion is digested for some time with an alkaline chloride. This is possibly, and, I think, probably one of the ways in which the pink and red vulcanites prove injurious. I am not sure of the exact decomposition; it may probably be represented as follows:—



I have, however, found, as I shall again remind you, that bisulphide of mercury is capable of being sublimed at very low temperatures. But as regards the first method by which it may prove injurious, namely by decomposition and solution in the presence of heat and an alkaline chloride, I must remind you that not only are chloride of sodium and chloride of potassium present, though in small quantities, in normal human saliva, and under some special circumstances, such as catarrh and pneumonia, in abnormally large quantities in the altered mucus of the digestive and respiratory tracts; but that many of our patients use large quantities of salted provisions, or eat much of this condiment with their food.

Again, portions may be worn off the vulcanite plates containing the pigment, and carried into the stomach, there again to meet with chlorides,

and a temperature of about 38° Centigrade, or a trifle more. I must own, however, that in fair wear of well-constructed vulcanite plates the quantity worn off is very slight indeed. Perhaps some members of the Society can give us details of the actual loss of weight in plates worn for a given number of years.

More often, I think, portions of unmixed pigment escape from cracks or fissures, either in the solid form or in the shape of vapour.

It is noteworthy that in all my cases, and in nearly, if not quite, all those told by others, the symptoms of poisoning were first localized in the mouth. I think we must allow something for a slow process of molecular decomposition induced by the presence of molecules of water or saliva, aided by heat, the molecules of water being charged with electric forces. It is possible, too, that the carbon of the vulcanite, with the bisulphide of mercury and water or saliva, forms a constant battery, which is slowly but continually liberating mercury from the vermilion.

Whatever may be the way in which the vulcanite thus coloured acts injuriously, I think there can be little doubt that it sometimes does so. Upwards of a dozen cases have now been seen by me, and, as you see by the Appendices IV. and V., other cases are reported from America. Before enumerating the symptoms present in these cases, it may be as well to summarize the grounds

or evidence which induced and induces me to refer them, in the particular cases, to the use of pink or red vulcanite. They may be reduced to four, for the sake of brevity and clearness, viz. :—

(1.) The correspondence of the symptoms with those of chronic or sub-acute mercurial poisoning ; coupled with

(2.) The absence of other adequate cause, or “sufficient reason,” except the pigment in the vulcanite ;—no other source of mercurial poisoning being discoverable in the shape of medicines, cosmetics, or otherwise.

(3.) The discovery of mercury in the *saliva* of some of the cases ; in the *urine* of other patients ; and, in one case, in both the saliva and urine. As may be readily imagined, there are difficulties in the way which prevent this analysis being performed in all the cases. Lastly :—

(4.) The remarkable agreement in the time at which symptoms appeared in most of the cases ; from six weeks to two or three months being a usual period for the symptoms to become well marked ; but above all, the *disappearance* of the symptoms when the vulcanite was removed, and their *reappearance* when the wearing of the plate was resumed. In Case V. of those reported in the *Medical Press and Circular*, this disappearance and reappearance happened more than once,—indeed, three times.

I do not propose to trouble you with details of

the cases, as they have been published at some length in the medical journal referred to. The whole of the symptoms which I myself have observed may be classed as follows :—

I. Muco-cutaneous symptoms, or those affecting the mouth, alimentary canal, and skin. Of these the chief are :—

(1.) Stomatitis, with sores of a deep, ragged, and spongy character, on the gums, cheeks, palate, and tongue ; sometimes extending to the pharynx.

(2.) Salivation, usually profuse.

(3.) Great fetor of the breath.

(4.) A coppery or metallic taste in the mouth.

(5.) Anorexia.

(6.) Indigestion of an adynamic type.

(7.) Diarrhœa, somewhat resembling dysentery, like that sometimes exhibiting blood in the stools. This may, however, be preceded by constipation.

(8.) Herpetic eruptions about the lips.

(9.) Lichenoid and eczematous eruptions on the skin and mucous membranes, the papules and efflorescence in both cases being usually of a very vivid red, and attended with much itching and smarting (Lichen ruber and Eczema rubrum vel mercuriale).

(10.) In some of the cases there have been ecthyma, furunculi, pemphigoid and rupoid sores. With regard to the latter, it seemed to me that there was some doubt whether they may not have been due to constitutional syphilis.



II. General symptoms: the chief of which were:—

(1.) A general condition of malaise (this, perhaps, should come under the heading of neuroses).

(2.) Extreme muscular weakness, not unlike that of sea scurvy.

(3.) The blood became poor, watery, deficient in fibrine, the red-blood discs lost their tendency to adhesion; and the patients had a strong tendency to local hæmorrhages, such as epistaxis, melæna, &c., and also cutaneous ones.

(4.) A general condition of feverishness: the state known as “mercurial fever.”

(5.) Great feebleness of pulse, and weakening of the power of the heart, and of the intensity of the first sound of that organ.

(6.) Marasmus. In some cases the loss of flesh is very striking. In others, a lowlier form of tissue may replace muscle; and hence there may be corpulence, rather than a haggard appearance.

III. Nervous symptoms, of which the chief are:—

(1.) Irritability of temper in a marked degree.

(2.) Want of sleep; due in some of the cases to the itching of the skin, but present in some without any skin disease.

(3.) Extreme restlessness and mobility, with general hyperæsthesia; in other cases, or in a later stage, some anæsthesia.

(4.) Either hysterical symptoms, even in males ; or great despondency, dread, and a condition closely allied to insanity ; hypochondriasis in its worst form.

(5.) Illusions, and in some cases delusion ;— thus, when the muscles are tremulous, the state closely resembles delirium tremens, in a mild form. (I may, perhaps, be allowed to remind you that in poisoning by the fatal ethyl and methyl compounds of mercury, the mind is still more seriously affected before death. In lead-poisoning, as well as in poisoning by arsenic, barium, and other metals, the mind is often affected.)

(6.) Trembling of the tongue and other voluntary muscles, as in gilders' palsy.

(7.) Loss of power in both upper and lower extremities, and loss of co-ordinating power, especially in the arms and legs. In one case the right arm was most affected, and as there were also cramps, the case resembled Scrivener's palsy. There was no local condition in this case to account for the writing-hand being especially affected. The patient, however, was a literary man, who used the pen a great deal. He was cured by leaving off the plate.

We must not expect to get all these symptoms in any one case. Usually we shall get the mouth and general health affected first with the slighter nervous symptoms. At a later date, and in more severe cases, the diarrhoea, hæmorrhages, emacia-

tion, and pareses, as well as the more marked mental lesions.

I now turn to the experiments made by me to try and elucidate the subject. They have been very numerous, including as they do, the examination of the many samples of rubbers previously mentioned. The result of these earlier experiments you know. The most interesting and most important of the others, in my judgment, are:—

I. Experiments showing the easy volatilization of vermilion, at comparatively low temperatures.

About three square inches of red vulcanite plate were broken up into small pieces, and different portions exposed (under water or saliva solutions) to temperatures varying from  $100^{\circ}$ — $150^{\circ}$  Fahrenheit ( $38^{\circ}$ — $65.5^{\circ}$  Centigrade). After a few hours, even at the lowest temperature named, some vermilion was found on the bibulous paper covering the glasses.

In repeating this experiment care must be taken to keep the paper itself *cool*, as the cinnabar might be lost by a second volatilization.

A similar experiment was made with a whole plate having a fault, with a like result.

II. Experiments showing the solution of pigment in saliva:—

Portions of vulcanite plates, coloured with vermilion, were macerated in saliva for some days, at a temperature of  $38^{\circ}$  Centigrade (about  $100^{\circ}$

Fahrenheit). The result was that on acidulating with HCl, electrolysis showed the presence of mercury by depositing that metal on a copper plate.

These experiments were repeated, and varied by the use of artificial saliva. Others were made with sulpho-cyanide of potassium alone. In weak solutions these were not successful. I did not consider the use of stronger solutions fair, as the percentage of sulpho-cyanides in normal saliva cannot be large. The total salts, according to Frerichs, do not amount to more than 59 parts in 1,000, of which the salts altogether only amount to 22·9, or less than a quarter grain per cent.!

III. Experiments to show the behaviour of vermilion in stronger solutions of chloride of sodium, &c.

I have already alluded to these, and to the use of salt as a condiment. I will, therefore, only say that I tried various strengths of saline solution (from 10 to 30 per centum), at a temperature of about 38° C. (100° Fahrenheit), digesting the coloured vulcanite in the solution for some days. The result was, that I never failed to detect mercury, apparently in the form of sublimate, by means of electrolysis. In the case of the strong solutions, a copper-plate was often sufficient, without a battery. I used the sodium chloride pure; but I think it is obvious that the commercial article is *more*, rather than less, likely

to produce a similar result. I varied the experiments by using potassium and ammonium chlorides, but the results were similar. I have previously given a probable formula for the decomposition.

IV. I made some experiments with acidulated saliva, and acidulated saline solutions, using acetic and hydrochloric acids. (I did not try lactic, although this might, perhaps, be worth trying, as well as phosphoric acid.) Except in the case of hydrochloric acid, I obtained no striking results. In the latter case, I am not sure that the hydrochloric acid really helped the solution. Although one might fancy this sort of formula—



yet, as a matter of fact, hydrochloric acid alone does not seem to act upon vermilion. These later experiments were, therefore, unfruitful. Inasmuch, however, as we are told by some chemical physiologists, that caustic alkalies exist as such in the blood, it might be interesting to note the effects of dilute solutions of these upon the rubber, aided by heat. The effect of strong caustic potash and heat being, as is well known, to liberate metallic mercury, which condenses in globules.

The last points to which I wish to draw attention are as to what can be done to remedy the evils I have thus pointed out.

The only suggestions I have to offer are the following:—

(1.) It appears evident to me, that great care in making the rubber first, and in hardening it after, so as to insure in the first a thorough mechanical mixture of the pigment, and in the hardened plates an absence of “faults” (cracks or fissures), would, undoubtedly, minimize the risk; although I had one case with a very well-made plate.

(2.) Several of the patients (some ten or more of my cases) had worn the plates all day long, and at night also. Some had not been careful to keep them clean. I doubt not that careful cleansing (in *soft* water, if possible), and leaving off wearing the plates at night, would very much lessen the dangers of such poisoning;—added to the occasional use of an astringent lotion for the mouth, such as myrrh with tannic acid.

(3.) It has occurred to me that it might be possible to glaze, or rather *glass* the plates over, when finished, with some one or another of the silicates; in fact, to enamel them. Even a varnish might, perhaps, last long enough to be worth trying.

(4.) After all, the great desideratum seems to be, to get a good substitute for vermilion; or, as there seem to be chemical difficulties in the way of this, for *rubber* itself. No doubt many will be sorry to lose such a material,



yet (although this is not the subject of my paper) there are some objections to rubber *per se*, and I fear there would still be some complaints about the rubber, even if we got rid of the vermilion. The contact of the rubber is too close, and its effects upon mucous membrane may be illustrated by the action of an india-rubber stall, when tight, upon the finger. Removing the plates from the mouth from time to time obviates this in part. But I believe, if we are in earnest, that good substitutes for rubber may be found—I mean, of course, equally cheap, or cheaper—and more healthy. I do not say “*Celluloid*,” for of this I have no experience. It has occurred to me that in the case of large plates it might be possible to *perforate* the artificial palate, let us say, with small holes, admitting air freely to the mucous membrane. Such holes, however, would only *increase* the danger in vulcanite coloured with vermilion, or with any poisonous pigment capable of solution.

I must crave your pardon for the undue length to which this paper has extended. I have tried to render it as brief as is consistent with clearness, but still it is a bulky one. I hope some discussion of it will not only be permitted, but undertaken; and if there are any points I have not rendered clear, I shall be happy to give explanations at the close of the discussion.

## APPENDIX.—No. I.

EXTRACT from a paper read by Mr. Putnam, of New York, at a Meeting of the Odontological Society, held April 2, 1859. Vol. I. of the "Transactions," pp. 141—157. (Kindly pointed out by Mr. Turner.)

"It has been suggested that the use of vermilion in the material gives us in the piece one of the forms of mercury, and that with those *who cavil at trifles* [the italics are mine.—W. B. W.] serious objections would arise against its use. We reply, that if the work decomposes, wears away to any extent, or absorbs the fluids of the mouth *one jot or tittle* [these italics are in the original], which has yet to be proved, then I submit it for your decision as to what extent of injury can possibly arise to those who wear it?"

## APPENDIX.—No. II.

AT a Meeting of the Odontological Society, held June 4, 1859, Mr. Childs read a paper on "Superheated Steam," from which I extract the following:— (For this reference, also, I am indebted to Mr. Turner.)

"As the heating and hardening progress, the substance (rubber with sulphur) becomes darker in colour, one evidence of its being richer in carbon; it also gives out at the same time a great deal of sulphuretted hydrogen, that is, the hydrogen leaves the carbon and takes to the sulphur, forming a gas; and it is the formation of this gas which makes a certain amount of pressure necessary to prevent this gas forming globules in the rubber, which it will without pressure; and hence the porosity which is so often found in *sulphur and rubber hardened by dry heat*. . . . I have also found that more sulphuretted hydrogen is evolved with the presence of saturated steam when under pressure than with sub-saturated steam, which is

accounted for by the rubber compound being slightly porous, and thus enabling a greater amount of moisture to act upon the rubber, and carry away more of the sulphur and hydrogen than is necessary; for water exerts the power, in an extraordinary manner, of decomposing all organic substances under heat and pressure; and further, also, as the pressure of saturated steam requires to be greater than in the case of sub-saturated steam. If the heat be carried too far, a substance like charcoal is produced, very porous. . . . I have learnt upon the authority of Messrs. Macintosh & Co., confirmed by my own experience, and some careful experiments by Mr. Vasey, that rubber will take up, with but little change of bulk, more than half its weight of impurities; if these be oxides, acids or caustic alkalies will readily decompose the compound with heat."—"Transactions," vol. ii., pp. 197, 198.



#### APPENDIX.—No. III.

At a Meeting held December 3, 1868 :—

"It might be well to take notice here of one of the greatest objections frequently urged against the use of vulcanite. I allude to the injurious effects it is said to produce upon the mucous membrane of the mouth of some patients, and even to affect their constitutions generally. It has been alleged that small ulcers, sores, and other symptoms of salivation, both local and general, have been exhibited after the use of rubber-cases, resulting, it is said, from the bisulphurate of mercury or vermilion, used as a colouring agent in the manufacture. . . . So far as I have been able to inquire into the matter, I have not been able to detect free mercury in any of the numerous rubbers which have come under my observation. . . . I see no evidence to show that it can be acted upon by the secretions of the mouth, more especially when retained in combination with the hardened rubber compound. Even if it did so, I am not disposed to think that the small quantity which the surface of a rubber piece would yield could affect the mucous membrane or constitution to the extent which it has been stated these cases have

done. I must conclude, therefore, that the effects produced are due to other causes than to the presence of mercury in the rubber; to some peculiar idiosyncrasy in the constitution which would reject any other than a gold base in contact with the gums; or to some general derangement of the system at the time of inserting the piece, and quite independent of it. Such cases may, I think, be fairly classed with others of a similar character, which we have heard of in connection with the use of amalgam plugs, cases of which we hear, but happily never see, and which may be frequently assigned to other sources than those assigned to them."—From a paper on "Hard Rubber," by Mr. R. Hepburn, "Odontological Transactions," vol. v, p. 185. [This reference also was given me by Mr. Turner.]

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#### APPENDIX.—No. IV.

FROM the *Pennsylvania Journal of Dental Science*, September, 1874, Vol. i., No. ix., p. 383. In reporting the proceedings of the Southern Dental Association, in session at St. Louis, July 28, 1874, it quotes Dr. Walker as saying, "that he had always been an uncompromising opponent of the use of rubber as a base for artificial teeth, and another year's experience had only confirmed him in his opinion on the subject. He preferred *celluloid* above all other material for that purpose. Regards the rubber as extremely injurious to the mucous membrane of the mouth, and poisonous to the system. He has seen many bad results, and in no case has he seen the good result we look for in artificial teeth. He had given the matter much and close study, and was satisfied that his position was correct. His own wife had worn rubber for three years, and the effect was to ruin her health. He was not convinced that this was the cause until he tried an experiment upon his own mouth, with a like effect. By watching the effects of the same agency in numerous other cases, he placed the matter beyond all doubt. Almost universally he noticed that it not only made the mouth sore, but it had such an effect upon health as to reduce the weight of the person

very considerably, the person returning to his normal condition as soon as the cause was removed." Dr. Judd found that the red rubber plate is far more injurious than black rubber, and cited an instance in which the two rubbers were mixed, the part touched by the black being comparatively healthy, while that touched by the red rubber was greatly irritated, and even inflamed. He knew of several cases where the disease had extended to even the bones of the mouth, completely destroying them (!). . . . . Let any one, no matter how healthy his mouth, place a small quantity of red sulphurate of mercury in his mouth, and allow it to remain for a while, and he will find the parts to become almost immediately affected."

Dr. Johnstone had seen some very serious cases of disease which have arisen from red rubber, and he has seen one or two cases of several years' standing, which were cured by simply substituting a metal for a rubber plate." Dr. Cobb, of Nashville, believed that disease arises more from the fact of a foreign substance being in contact with the mucous membrane than from the nature of that foreign substance. *He admitted, however, that there are more cases of disease with rubber plates than from silver or gold.* [Italics are mine.—W. B. W.]

A committee was appointed, with instructions to submit vulcanized rubber to a chemical analysis, and report at their next meeting.

[Mr. Turner kindly gave me this reference also.]



#### APPENDIX.—No. V.

EXTRACT from the *Dental Cosmos*, Vol. xvi., No. xi. November, 1874 (Philadelphia, S. S. White, Publisher), p. 601.

Report of the American Dental Association, Morning Session, second day.

"The report then adverted to the action of the colouring matter in vulcanite upon the mouth, and its effects upon the health. There are two opinions: the minority think it highly injurious, while the majority claim that it is inert. Ver-

million is six parts of mercury to one of sulphur, and forms thirty-six per cent. of the whole mass of rubber. . . . The tendency to "flower," or appear in minute globules, may, by the globules being liberated by friction on the palate, and the decomposing action of light, free a small quantity of mercury, which being introduced into the stomach in a finely divided state might be acted upon by the acids there present, and the active chlorides of the metal produced. Some varieties are adulterated with arsenic, &c., to which the deleterious effects may be due. In such cases, however, it should be ascertained whether mercury has not recently been taken. It may, indeed, stay a long time in the system, and then suddenly manifest itself after taking, for example, the iodide of potassium."

[For this extract also I am indebted to Mr. Turner.—W.B.W.]

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